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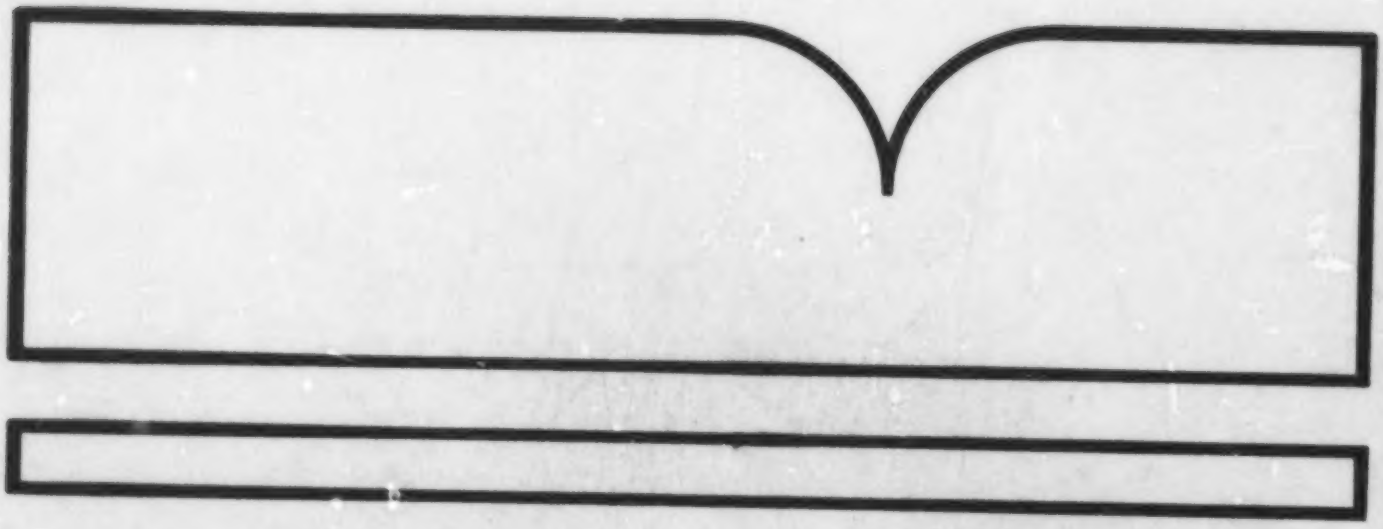
NATO-CCMS Pilot Study on Disposal of Hazardous Wastes (Phases I and II)

NATO Committee on the Challenges of Modern Society, Brussels (Belgium)

Apr 81



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Objective of study defined as follows: (1) to define and analyze technical, organizational and regulating ways and means for the proper disposal of hazardous wastes, (2) to compile and evaluate various management approaches to the solution of the hazardous waste problem, and (3) to draw conclusions from the previous analysis and work out recommendations where possible. The conclusion, after seven years of intensive work, is that the pilot study is thus far the most comprehensive and effective international effort in the area of hazardous waste management.

KEYWORDS: *Hazardous materials, *Waste management, *Foreign technology.

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NATO CDSM
OTAN CCMS

COMMITTEE ON
THE CHALLENGES OF
MODERN SOCIETY

DISPOSAL OF HAZARDOUS WASTES

FINAL REPORT
(Phases I and II)

NATO CCMS

OTAN CCMS

THE CHALLENGES OF MODERN SOCIETY

DISPOSAL OF HAZARDOUS WASTES

FINAL REPORT (Phases I and II)

Number 122

NORTH ATLANTIC TREATY ORGANIZATION

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NATO CCMS Pilot Study

DISPOSAL OF HAZARDOUS WASTES

FINAL REPORT

(Phases I and II)

April 1981

This report is printed on recycled paper

Pilot Study Final Report

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Pilot Study "Disposal of Hazardous Wastes"

Final Report

I. General Overview

1. History and Time Table of the Pilot Study

In recognition of the great and growing importance of hazardous waste generation and disposal to environmental protection and economic development, and considering that international cooperation could contribute effectively to a better understanding of the complex nature of the problems involved, the Pilot Study "Disposal of Hazardous Wastes" was originally proposed by the Federal Republic of Germany at the Fall 1973 CCMS Plenary.

The proposal was made at a time when numerous environmentally unsound hazardous waste disposal activities were reported in most industrialized countries. There was, and still is, an obvious need to improve the situation in this area of environmental control. Governments of nearly all NATO countries recognized this challenge and were responding at the time by preparing or reviewing legislation and regulations to control the flow of hazardous wastes into the environment and to avoid further mismanagement. In this respect the proposed Pilot Study was received with particular interest among NATO Allies and other international organizations.

The Pilot Study was approved by the NATO Council in November 1973. The Federal Republic of Germany acted as the Pilot Country, the United States as Copilot.

The actual work programme was performed in two phases. Phase I started in November 1973 and ended in October 1977 with the submission of a formal final report to CCMS. Then, at the Fall 1977 plenary session CCMS agreed that the Pilot Study on the Disposal of Hazardous Wastes should continue into a second phase for another three years.

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The report that follows includes the results of Phase I of the Pilot Study and also summarizes the work programme and findings of Phase II. In addition, the report addresses priority areas of hazardous waste management which need special attention and consideration in the future. Finally the report gives an indication about how to continue international cooperation in the field of hazardous wastes among NATO countries after the completion of the Pilot Study.

2. Objectives

Based on the results of an Experts meeting convened at Bonn in September 1973, the general objectives of the Pilot Study were defined as follows:

- to define and analyse technical, organizational and regulatory ways and means for the proper disposal of hazardous wastes;
- to compile and evaluate various management approaches to the solution of the hazardous waste problem;
- to draw conclusions from the previous analysis and work out recommendations where possible.

The Pilot Study was not limited to technological and scientific problems as are many other CCMS projects. Basic policy issues of waste management also were discussed as were economic, legislative and regulatory aspects and measures as framework conditions for concrete actions in practice. In this way, the Pilot Study was able to analyse and clarify a great number of complex interrelations between technical and non-technical factors influencing the hazardous waste problem.

After seven years of intensive work, the conclusion that the Pilot Study is thus far the most comprehensive and effective international effort in the area of hazardous waste management seems to be justified. In the framework of the Pilot Study programme, nearly all important topics of the problem were investigated. The results have been summarized in 12 official

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CCMS documents altogether which give valuable orientation and guidance to national and international hazardous waste management authorities and policymakers.

3. Number and Contents of Pilot Study Projects

The Pilot Study group selected specific problem areas for discussion and agreed on a well-defined working programme. Altogether ten individual projects were chosen:

Phase I (1973 - 1977)

- landfill research and landfill practice
- underground disposal
- transportation
- organization
- recommended procedures for hazardous waste management
- chromium cycle

Phase II (1978 - 1981)

- thermal treatment
- chemical, physical and biological treatment
- landfill research (continuation of phase I)
- metal finishing wastes

Each of the projects was implemented as a self-contained effort receiving inputs from different participating countries. Although there was a certain link between some topics of different projects, the work-programmes of the individual projects were more or less independent of each other. Nevertheless, due to the close cooperation of the members of the Pilot Study group, conclusions reached in the projects tend basically in the same direction whenever more general questions were addressed.

Special emphasis was put in the work programmes on gathering information on the state of the art in NATO-member countries

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with regard to the topics defined. By collating and evaluating this information, a broad spectrum of activities and various options in the field of hazardous waste was presented. A particular merit of the Pilot Study is that it improved considerably the mutual knowledge of international developments in the hazardous waste disposal area.

It is important to note that the Pilot Study group faced basic difficulties in making general recommendations in the problem areas dealt with in the Pilot Study. Solutions to the hazardous waste problem depend by their very nature on particular national circumstances, e.g.,constitutional structures, legal situation, density of population or geological and climatic conditions. These factors vary considerably among the participating countries. Moreover, many questions raised within the projects often do not fall under the responsibility of central government but have to be decided at a more local level according to the specific circumstances involved. Therefore, the output of the Pilot Study is characterized more by a set of different and flexible alternatives than by uniform and ubiquitous recommendations. Precisely because of this diversity of suggestions, the results of the Pilot Study should serve as a valuable tool for practical decision-making in member countries, and in the international community at large.

4. Participation

The following nine NATO member countries were actively involved in the work-programme of the Pilot Study: Belgium, Canada, Denmark, France, Netherlands, Norway, United Kingdom, United States and Federal Republic of Germany. In addition, the Commission of the European Communities made written contributions to the Pilot Study.

Italy, Portugal and Turkey sent observers to some expert meetings as did the Organzisation for Economic Cooperation and Development (OECD), Japan and Mexico.

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5. Number and Character of Pilot Study Meetings

In all, twelve international expert meetings have been held by the Pilot Study group since 1973

Phase I:

Munich	September 1974	
Ottawa	June 1975	
London	October 1975	(just Landfill project)
London	October 1975	(just project on Recommended Procedures for Hazardous Waste Management)
Bad Hersfeld	December 1975	(just Underground Disposal project)
Bonn	May 1976	
Washington D.C.	May 1977	

Phase II:

Munich	September 1978	
Amersfoort (Netherlands)	March 1979	(just the project on landfill research)
Vancouver	June 1979	
Angers	October 1979	
Oslo	October 1980	

6. Dissemination of Pilot Study Reports

In order that NATO member countries derive the maximum benefit from the work done within the Pilot Study it is necessary to provide a wide distribution of the project reports. This information should reach experts in both government (local and national) and industry. Approximately 10.000 copies of eight official NATO CCMS documents which were published on the results of Phase I of the Pilot Study have in the meanwhile been distributed worldwide. With the consent of the CCMS it is now intended that a private enterprise (Plenum Publishing Company Ltd.) will take over the printing and distribution of all CCMS documents of this Pilot Study. Thus worldwide dissemination is ensured.

...

II. CCMS Resolution on Disposal of Hazardous Wastes

NATO member countries do resolve:

(1) to ensure a wide dissemination of the findings of the project reports of this Pilot Study to national governments, local authorities, private industry, scientific community and international organizations

(2) to pursue the fruitful exchange of information regarding hazardous waste disposal

(3) to consider the conclusions of the Pilot Study projects as guidance to solve the hazardous waste disposal problem

(4) to use their best efforts to implement the specific recommendations resulting from the projects of the Pilot Study

(5) to continue and promote close cooperation amongst themselves by establishing a standing committee of governmental experts under the terms of reference stated in chapter VII of the Pilot Study final report

III. Basic Principles for Hazardous Waste Management

The participating countries agreed on the following fundamental concepts and options for an effective and integrated hazardous waste management programme:

Management of hazardous wastes means the organized, systematic channeling of wastes through pathways to assure their recovery or appropriate disposal with acceptable public health and environmental safeguards.

Fundamental to any hazardous waste management planning are attempts to reduce wastes at the source through process changes, material substitutions and modifications in light of appropriate economics. To the extent that wastes are already minimized, separation and concentration of hazardous wastes are often important in order to reduce special handling and management requirements and increase reuse opportunities. Such concentration will occur as air and water pollution control systems

...

remove noxious pollutants from waste streams.

An important option in hazardous waste management is the concept of a hazardous waste clearinghouse, that is, to use the waste as is (if possible). One man's waste can be another man's feedstock. Minor process modifications enhance the possibilities for exchange as well. The clearinghouse concept is already being utilized in more than 13 countries including Austria, Belgium, Canada, France, Netherlands, Norway, Sweden, Switzerland, Denmark, Finland, Federal Republic of Germany, United Kingdom and the United States.

As some hazardous wastes contain valuable basic materials, material recovery makes sense as a next step from both resource conservation and environmental viewpoints. As material shortages and regulatory controls become more widespread, material recovery from hazardous wastes will become more economically attractive. If the hazardous wastes cannot be used or materials recovered from them and if they can be safely burned, destruction by incineration with energy recovery would be a desired alternative with due consideration for air emission controls and residual disposal. Traditional land-based incineration as well as ship-board combustion of wastes are options considered viable in several countries. Nonburnable wastes should be detoxified and neutralized by physical, chemical, or biological treatment, again when necessary and feasible, to reduce special handling and management requirements and minimize the amounts of hazardous materials destined for land disposal. The need for such treatment may be a function of economic constraints and local conditions, such as the availability of suitable landfill sites, in certain countries.

Controlled landfill forms an essential element in the ov rall disposal strategy. For hazardous wastes disposed of by landfill, volume reduction to minimize land use requirements and to facilitate disposal may be desirable. Isolation techniques (such as waste encapsulation) may be necessary prior to land burial in specially designated landfills in order to assure environmental integrity of the landfill site. Some landfills may require natural or artificial liners under disposed waste to prevent contamination of underground waters. Even if incineration or chemical, physical and biological treatment options are used, landfills will be needed for the residues of these processes.

...

Some countries find that the use of mines (isolated underground areas) or deep injection wells can be reasonable disposal options for selected wastes.

Each country has a somewhat different view as to the emphasis to be placed on any of the succession of disposal options. Also the options should be considered in the light of the quantity and concentration as well as the type of the waste.

IV. Summary, Conclusions and Recommendations of the Pilot Study

The ten projects of the Pilot Study dealt with a number of central problems of hazardous waste disposal. The following sections of this final report contain brief summaries of the work which has been done and the main conclusions and recommendations derived within the individual projects.

A. Organization Project

(a) Lead country: Federal Republic of Germany

(b) Participating countries: Belgium, Denmark, Federal Republic of Germany, France, Netherlands, United Kingdom and United States of America.

(c) The project aimed at a survey and an evaluation of organizational and legislative measures in the field of hazardous waste management in participating NATO countries. The effort undertaken particulary addressed problems of control, planning and organizational execution of hazardous waste disposal. It covered not only questions falling under governmental responsibilities but also included respective actions in the private sector.

The project concentrated on the following aspects:

(1) Legislative basis of organization of hazardous waste disposal, e.g., discussing

- regulations on control of waste flows
- regulations on licensing of disposal facilities
- planning regulations

...

- regulations on particular forms of organization
- regulations on liability, financing and insurance

(2) Practical application of existing regulations to (1)

(3) Developments which take place by private initiatives, e.g. waste exchange systems

(4) Evaluation of advantages and disadvantages of different organizational schemes with special regard to general waste disposal policies in participating countries

The information necessary for reaching the project objectives was obtained from replies to detailed questionnaires circulated to the NATO countries and discussion at the expert meetings.

Conclusions

1. The possibilities of establishing certain organizational systems for the disposal of hazardous wastes have to consider the constitution, the legal system and the political objectives of the country concerned.

2. Adequate waste disposal requirements (standards) on a national level are of importance for the organization of hazardous waste disposal. Such standards would, for example, facilitate control measures such as licensing of facilities, and help to improve planning as well as financing of facilities.

3. The organization of disposal of hazardous waste will often be improved by use of disposal facilities with a large capacity.

4. The control of hazardous waste transport is of special importance.

5. The disposal of hazardous wastes and the operation of disposal facilities is not in priciple the responsibility of the central or local government; the

...

waste-generating industry as well as private enterprises have to take over important tasks in this field.

6. Even if waste disposal is organized on a private basis, it may be necessary for government - owned, government-controlled or joint facilities to be available, if capacity of the private system proves to be inadequate.

7. The classification of hazardous wastes is of importance for the organization of their disposal as a basis for planning and control.

8. Financing of facilities for the disposal of special wastes constitutes a problem, irrespective of the ownership of these facilities. This problem can be solved by the provision of financing mechanisms. The financing from general budgetary funds only appears justified in exceptional cases.

9. Based on the polluter-pays-principle, the following concepts of facility financing seem possible:

   - financing by the operator with cost passed on to the clients
   - financing by industries, also by joint ventures (industry-owned facilities)
   - financing by public bodies using a fund supplied with payments from waste producers

   or by a combination of the above

10. Private investments for facilities can only be expected when there is a "market" for such facilities and when the use of such facilities is either enforced by legislative measures or acceptable to the waste producers at fees which guarantee a profit for the operator.

11. Legal enforcement of obligatory use of licensed facilities can be regarded as a strong means to encourage financing of facilities out of private sources.

...

12. From the point of view of liability and safety, the financial responsibility of disposal enterprises is of special importance. These aspects can also be taken into account by imposing the obligation to take out insurance or by other appropriate measures, such as performance bonds.

13. The problems of financing the long-term care of landfill sites for hazardous wastes after site closure are still largely unsolved and need further clarification.

Recommendations

1. A harmonization of technical and safety standards for waste disposal on the international level would help international cooperation in this field and should therefore be envisaged.

2. An essential task is the planning of the disposal system. Government authorities have to consider their responsibility in this area. It should be carried out in close liaison between the authorities responsible for the disposal of hazardous wastes, the disposal enterprises and the interested groups from industry, and the public, and with regard to disposal of other general wastes.

3. The planning of sites for facilities for the disposal of hazardous wastes should at least be undertaken for a fairly wide region. The preparation of individual plans should take account of overall planning requirements.

4. For facilitating disposal of some hazardous wastes in wide areas, the establishment of collection centres should be considered. Due regard has to be given to the fact that the establishment of collection centres might increase overall costs of disposal. Some of the collection centres should be equipped with facilities for waste pretreatment.

...

5. The disposal of hazardous wastes requires controls by government authorities. Controls should extend to the licensing and verification of facilities and to the disposal route (from waste generation over transport to ultimate disposal).

6. The method of implementation of legislative measures on control issues has to relate to whether organization is carried out by private enterprise or by public bodies, i.e.,external control of private initiative organizations whereas control of public bodies should be obtainable by means of internal control.

7. When licences for waste disposal facilities are granted, the restoration and stabilization of the utilized terrain after closing of the facility should be provided for by appropriate measures. As much as possible the costs of restoration or stabilization should not be borne by the public.

8. Among the possible measures for the control of the disposal of wastes, controls at the source (i.e. control of waste generation) should be given priority.

9. Waste exchanges or clearinghouses are an effective organizational means to increase the utilization of industrial residues. Their establishment, maintenance and effectiveness should be encouraged by appropriate measures. Any direct government involvement with the organization and operation of waste exchanges is likely to satisfy matters of confidentiality.

10. Financing is strongly linked to legislation on forms of organization, (i.e., ownership of facilities), areal coverage of facilities and on control measures. It has thus to be borne in mind that these conditions must fit into the concept of financing.

11. If an organizational scheme is based on facilities run by public bodies due regard should be paid to the polluter-pays-principle.

...

12. The prices charged for the disposal of hazardous wastes should be based on the disposal costs including investment amortization, proper facility closure and long term care. Where appropriate to the particular country's attitude, possibilities to achieve equal price levels should be explored in order to compensate for site disadvantages.

13. Subsidized disposal prices should only be envisaged in strictly limited cases, for example, to introduce new technologies or for research purposes. The possibilities to grant low-interest loans for investments, however, should be investigated.

14. Where appropriate to the particular country's attitude, the costs of transport from the collection centres to the disposal facilities should be included in the disposal costs in order to avoid site disadvantages and to equalize disposal costs. To avoid restrictions in the field of transfrontier waste transport and disposal, reasonable uniform requirements should be envisaged in the different countries.

15. Sites of a particularly favourable nature should be (also internationally) made available not regarding the origin of wastes - but with due regard to the cooperative principle. This requires close cooperation of public authorities both on a national and international level. Limitations of capacity and the avoidance of unnecessary long transporation of the wastes have to be taken into consideration.

B. Project on Recommended Procedures for Hazardous Waste Management

(a) Lead countries: United States/Canada

(b) Participating countries: Canada, Denmark, Federal Republic of Germany, France, Netherlands, United Kingdom, United States of America

Contributions to the project were also made by the Commission of the European Communities.

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(c) The project addressed the following topics:

(1) Definition and classification of hazardous wastes

(2) Waste sampling and analysis

(3) Site selection (including citizen acceptance)

(4) Long-term care of hazardous waste disposal facilities

(5) Permit processes

(6) Labeling

(7) Facility safety

The United States led topics (1) - (4), while Canada coordinated the work on topics (5) - (7).

In summary, the project on "Recommended Procedures for Hazardous Waste Management" focused on implementation issues that arise from consideration of the options for an integrated hazardous waste management programme. The topics group themselves around two themes: the identification of hazardous wastes and the authorization for operation of hazardous waste disposal facilities.

In the first place the project concentrated on an international comparison of alternatives either realized or planned with respect to the addressed problems. Because of the wide spectrum of different approaches in NATO countries the project did not result in definite recommendations. But comparisons and contrasts between concepts utilized by participating countries do provide useful insights and information for those who are interested in the problem areas.

Conclusions

1. Central to any programme to manage hazardous waste are the definition limits on those waste materials controlled by the management system. These definitions are designed to suit the nature of the environmental problem to be solved as well as the socio-political

...

and economic conditions existing in each country. Harmful effects as the result of a disposal act are in general the major criteria for statutory definitions.

2. There are basically two regulatory approaches for establishing a country's classification of hazardous waste: the list approach (enumeration of types of wastes) and the criteria approach. These approaches may be used singly or in combination.

3. A variety of hazardous waste lists have been developed in NATO countries and elsewhere. Although the methodologies differ to establish such lists a considerable international consensus exists regarding which materials should be classified as hazardous under disposal aspects.

4. Due to basic differences in hazardous waste management technology, political and economic structures of the various countries and the present lack of information on the properties of many wastes an international hazardous waste list seems not yet feasible.

5. In the criteria approach, hazardous wastes are identified by reference to general characteristics, such as flammability or a pH range. Techniques for sampling and analysing waste streams are essential to identify hazardous wastes under the criteria approach. There is an obvious need for standardized sampling and analysis procedures. Different waste types may well require different procedures.

6. There are usable, inexpensive techniques for analysing for most inorganic wastes of concern, especially heavy metals; the interferences involved in these techniques are understood to an extent and difficulties in that area can often be solved by pretreatment of samples.

7. The problem of organic waste analysis is far from being solved. The large number of potential constituents, their differing properties, the wide range of concentrations in which they may be present, as well as many mutual interactions between constituents make the problem of developing standard methods exceedingly complex.

...

8. Complications with pretreatment of samples and separation techniques make results from sampling and analysis often difficult to interpret. It is obvious that much work needs to be done in both areas.

9. Careful site selection for safe disposal of hazardous wastes is one of the most important first steps for controlling the long-term effects of the hazardous properties of the discarded materials.

10. Approaches to site selection of disposal facilities are generally in a developing stage in NATO member countries. There are still few examples where site selection processes have been formalized using some type of a systematic plan, e.g., a matrix or a decision tree.

11. Among site selection criteria, soil characteristics and groundwater conditions are the physical factors of greatest concern.

12. Site selection processes need close cooperation between competent authorities and experts on geology and hydrology.

13. The aspect of citizen acceptance is of increasing importance for site selection of hazardous waste disposal facilities. This acceptance often needs carefully prepared education and information campaigns.

14. Mechanisms for long-term care are still being developed as essential elements in a comprehensive system for hazardous waste disposal.

15. A rather common approach in NATO countries is to provide for (long-term) safe sites via more or less comprehensive licensing systems. The United States in addition, requires financial arrangements by the owner in order to provide money for proper site closure and for long-term

...

care and monitoring of disposal sites after closing them down. Comprehensive provisions for long-term care will necessarily include both of these provisions.

16. It is necessary that decisions relative to waste disposal be reviewed at all stages of production and handling. Decisions prior to production are also very important.

17. Disposal facility performance permits are necessary to control

- facility safety and capacity
- waste products allowed for disposal
- disposal methods to be used for specific waste
- effluent and emission criteria
- record of wastes disposed of (particulary for land disposition of hazardous wastes for long-term control).

18. The identity of hazardous wastes must be maintained from production to ultimate disposal and decisions in hazardous waste disposal must be controlled. A trip ticket or waste manifest is regarded as a valuable control tool.

19. It is desirable, that the containers of waste products have markings which indicate in some manner the nature and degree of hazard associated with the product, and any special handling and disposal procedures which may be required if the waste is to be handled by second or third parties.

20. Containers of hazardous wastes handled within a facility or leaving that facility should be appropriately labelled. The label should indicate as a minimum

(a) Manufacturer's or producer's name and address

(b) Description of contents

...

21. The technology and techniques for handling hazardous wastes are essentially the same as handling other hazardous commodities, but the degree of uncertainty is much greater. Therefore, a proportionate increase in safety precautions should be taken at hazardous waste management facilities.

C. Underground Disposal Project

(a) Lead Country: Belgium

(b) Participating countries: Belgium, Canada, Denmark, Federal Republic of Germany, France, Netherlands, Norway, United Kingdom, United States of America

(c) The project focused on the analysis and the determination of the technical and economic circumstances and conditions under which hazardous wastes can be safely disposed of in inactive or partially active mines.
Particular importance was assigned to the problem of avoiding any water pollution.

The project summarizes the geological criteria and operational requirements which should be fulfilled as necessary prerequisites for underground disposal of hazardous wastes. Various mineralogical formations are described and evaluated with respect to ensuring permanent environmentally-sound storage of hazardous wastes. On the basis of a detailed analysis, a classification scheme is proposed for decisionmakers ranking individual mineralogical formations with respect to their suitability for underground disposal.

In a second step, the nature and composition of hazardous wastes are investigated which are most suited for underground disposal. Based on a analysis of the possible interactions of the wastes with the surrounding mineralogical environment, general criteria are given which have to be considered when selecting hazardous wastes for underground disposal.

...

Finally, the project evaluates those two practical applications of the underground disposal method which up to now have been realized in NATO-member countries. In the Federal Republic of Germany, an active salt mine provides particularly favourable conditions for the underground disposal of selected solid hazardous wastes. The second example described deals with an old coal mine in the United Kingdom which since 1965 has been used for the disposal of certain liquid hazardous wastes. This coal mine became blocked and does not receive further wastes at present.

Conclusions

1. An inactive mine which meets the geological and technical criteria defined by the project, constitutes the most acceptable solution for the underground disposal of solid hazardous materials. However, a mine with both active and inactive sections can be used for a double purpose at the same time: for exploiting a deposit and for disposing of hazardous materials.

2. Salt mines and potash mines seem to be the most adequate for the underground disposal of solid hazardous wastes. It is expected that in the near future the underground disposal method will be limited to salt mines.

3. The underground disposal of hazardous wastes should be authorized only under the conditions that it does not involve noxious effects for the biosphere and for the extraction of minerals or subterranean water.

4. The underground disposal method can be considered as a solution only for categories of waste materials whose production is inevitable and whose recycling, regeneration or any other method of elimination is not economically feasible with the existing techniques. Research on these alternative methods remains very necessary.

5. In summary, it is well to accept underground storing only when carried out under the strict technical

...

conditions explained in the project. Moreover, it would be well to strengthen the requirements still further if some danger were to arise about which one does not know enough at the present time.

6. The underground disposal of liquid wastes seems to be possible only in very few particular cases where a considerable number of favourable criteria must be assembled. The principal attitude to adopt for liquid wastes should be based on the recognition that until now one has only a limited understanding of the possible effects on the receiving mineralogical structures.

D. Transportation Project

(a) Lead country: United States

(b) Participating countries: Canada, Federal Republic of Germany, France, United Kingdom, United States of America

(c) This project addressed problems involving the transport of mixtures of hazardous substances as they occur in the form of hazardous wastes. In particular it was considered whether the current rules and practices for the transport of pure hazardous substances or goods do or do not provide adequate public health, safety and protection to the environment from the potential effects of hazardous wastes. Primarily this examination was undertaken by making reference to the United Nations Recommendations on the Transport of Dangerous Goods.
Transport in the sense of the project was understood as the actual shipment of materials requiring certain provisions for packaging, marking and labeling, vehicle placarding and vehicle and equipment standards. The different aspect of control of transport as part of the disposal chain of hazardous wastes was dealt with in the project on "Organization".

The transportation experts concentrated on the following two main issues:

...

- how to classify hazardous wastes in terms of the U.N. classification scheme for dangerous goods

- whether and how to take account of the long-term, chronic hazards of hazardous wastes in future U.N. Recommendations on the Transport of Dangerous Goods. Until now these recommendations generally consider only acute hazards in transport.

With regard to the classification problem, different lists of hazardous compounds and hazardous wastes were submitted by the Pilot Study group and analyzed by the transport experts. A large portion of the listed hazardous wastes which were characterized by one or two constituents could be generally associated with existing U.N. classification classes because of their acute hazards. The United Kingdom and the Federal Republic of Germany each proposed a classification scheme that would also be applicable to more complex mixtures of substances which occur as wastes.

Conclusions

1. With regard to transport, a large proportion of hazardous can be characterized in a simplified approach by one or two components constituting an acute hazard in transport in terms of either flammability, explosivity, toxicity or corrosivity. These wastes can be associated with the existing U.N. classes (for transport) without major difficulties.

2. However, for a certain portion of hazardous wastes, in particular, when they contain a mixture of many substances, attempts to solve the classification problem are still in a preliminary stage. Common criteria for tackling this problem have not yet been developed in NATO member countries. This complex subject requires close cooperation between transportation and waste management experts in the near future.

...

3. Some hazardous compounds and hazardous wastes analyzed in the project had to be classified in the UN class "Miscellaneous Dangerous Substances". These wastes need a more specified classification in the future.

4. Long-term environmental effects of hazardous materials are generally not considered in the current transportation rules. Existing labeling requirements seem to be insufficient for giving advice to cover environmental aspects, e.g., the prevention of water pollution by spillages.

5. The lack of criteria makes the establishment of a transport classification scheme for hazardous wastes with chronic effects more difficult than for wastes of the acute type.

Recommendations

1. The producer, shipper or any subsequent shipper of hazardous wastes should be responsible for selection of the packaging, labelling, placarding and vehicle equipment. The producers/shippers must clearly indicate to the transporter on the shipping paper (manifest) the information required to transport the hazardous waste to the disposer, including the composition of the hazardous wastes, as well as attaching to the shipping paper information necessary to prevent spills from endangering health or the environment in the event of an accident.

2. The U.N. Committee of Experts on the Transport of Dangerous Goods should be asked to established a new classification scheme for those hazardous wastes which do not meet existing U.N. criteria. Several options which could be considered are:

   a) New divisions under U.N. Classes 3, 6 and 8 i.e., Division 3.4 for flammables; Division 6.3

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for poisonus (toxic) substances; and Group IV for corrosives under Class 8.

b) Establishment of a new division for hazardous wastes in U.N. Class 9 (Miscellaneous Dangerous Substances).

c) Creation of a new U.N. Class 10 entitled: "Environmentally Hazardous Substances" for those wastes hazardous to health or the environment, but which do not meet existing U.N. criteria for the transport of dangerous goods.

3. The U.N. should be asked to develop a classification scheme for the transport of mixtures of hazardous wastes taking thereby into consideration the proposals of the Federal Republic of Germany and the United Kingdom, which were submitted to the project. Therefore, copies of both proposals should be forwarded to the U.N. Committee of Experts on the Transport of Dangerous Goods.

4. The Organization for Economic Development and Cooperation (OECD) should be asked to furnish the UN with classification criteria for the waste substances submitted by the Pilot Study group so that these substances can be made subject to U.N. Recommendations for the Transport of non-acute hazardous wastes, in particular concerning labelling.

5. Hazardous wastes of a chronic nature which might pose a hazard for health or the environment, but which do not meet the U.N. classification criteria for dangerous goods, should be considered subject to shipping paper and marking requirements so that the wastes can be controlled from producer to disposer, including requirements for handling spills due to accidents.

6. Divergent approaches by different international organizations to the environment problems occurring in transport of hazardous wastes should be avoided.

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E. Chromium Cycle Project

(a) Lead country: France

(b) Participating country: France

(c) Regarding the problem of chromium pollution, this project was proposed as a self-contained effort by France. It was carried out by commissioning a specific study on the French situation in that area. The primary objective of the study was to obtain better knowledge of the chromium cycle in French industry and of the pollution involved in the utilization at the various stages of the processing of the mineral, manufacture of the basic products, application for these products and their consumption. At the same time, the various techniques that could be used in solving the problems at issue, in particular those involving water pollution, were investigated in detail.

Although the study confined itself to a presentation of French conditions many results obtained can be easily transposed to other industrialized countries. This holds in particular for the technical elements of the study and the analysis of the environmental impacts of the use of chromium in industry. In this respect the project forms an useful guide for NATO countries to analyse their own situation in this area.

Conclusions

1. Toxic chromium wastes containing substantial quantities of chromium in its hexavalent form are only generated in chemical applications. The major source is the surface treatment industry. Another source of toxic chromium wastes is the use of chromium in catalysts and pigments and as an oxidizing agent in the chemical industry. Chromium wastes in trivalent form are generated in larger quantities by tanneries.

2. In metallurgical processes no toxic chromium wastes are produced. Losses of chromium occur essentially in the

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form of ores. Losses in slags are also neutral with respect to the environment.

3. In refractory applications chromium is incorporated in the form of insoluble products which are not harmful to the environment.

F. Landfill Project (Phase I)

(a) Lead country: United Kingdom

(b) Participating countries: Belgium, Canada, Denmark, Federal Republic of Germany, France, Netherlands, Norway, United Kingdom and United States of America

(c) The project dealt with two main topics

- landfill practice, and
- landfill research

including the extent to which hazardous wastes are disposed of by landfill. The objective of the work programme was to assess the contribution that sanitary landfill and special chemical landfill can make to the safe disposal of hazardous wastes, with primary regard to the prevention of both ground and surface water pollution hazards, but also of air pollution. As a result, more information was submitted concerning the water pollution aspects than on air contamination.

Conclusions

1. The extent to which landfill and special chemical landfill of hazardous wastes is practised in participating countries varies, but in general at present it represents an important method of disposal in almost all of the countries, and this situation is likely to continue for the foreseeable future.

2. In the countries which participated in the project, two main approaches to landfill have been adopted:

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a) Landfill is regarded as one of a number of options for waste disposal and forms part of the overall disposal strategy for various wastes including domestic, commercial, industrial and certain types of hazardous wastes.

b) Where restrictions on landfill of chemical or hazardous wastes apply, usually by legislation or because only a limited number of sites are available, there may still be specified exceptions to the limitation.

3. Continued use, for hazardous waste disposal, of landfill and special chemical landfill to some extent by almost all participating countries seems to be a generally accepted principle. Because of the considerable geological, hydrogeological, topographical, climatological and population density differences between the participating countries, it may not be possible to devise a single "management" approach to landfill of hazardous wastes for general use.

4. The importance of avoiding harmful effects of landfills is recognized in all participating countries. The most important of the possible effects is generally agreed to be the potential risk of pollution of water resources, and in particular contamination of groundwater.

5. Examples of pollution both of surface and of groundwaters due to landfill disposal of hazardous wastes have been reported by several participating countries. Where such incidents have been experienced, they seem usually to have been due to such factors as poor site selection, inadequate supervision, and incorrect methods of operation as well as insufficient knowledge about soil-waste interaction in the underlying strata, rather than to basic unsuitability of landfill as a disposal option.

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6. Because of the continuing importance of environmental protection measures in addition to the need to dispose of wastes safely to land, several countries have in recent years commenced extensive programmes of research into various aspects of landfill disposal. Such programmes are by nature fairly long-term studies, and it has not been possible within the time-scale of this project to examine the final conclusions of the various national programmes currently in progress. However, the project has provided opportunities for useful exchange of information on landfill research topics, and it has been possible to include in the project report some of the preliminary findings from the research programmes of several participating countries.

7. The wide range of topics and methods included in landfill research programmes are intended to provide the responsible authorities in each country with the guidance needed to develop future waste disposal policies, and to assist in defining the relevant legislative measures. From the large number of individual topics being investigated, it is possible to define three main areas of interest:

   a) How to minimise the leachate generating potential of wastes, and control the movement of any leachates that are produced within the landfill, and to study factors affecting movement of leachates away from the landfill.

   b) How to select suitable sites for landfills, with regard to geological, hydrogeological and other relevant parameters.

   c) What are the best methods for landfilling wastes of a particular type at a given site, including the extent to which co-disposal of different wastes can be used.

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8. In most current investigations, the main objective appears to be the understanding of the processes governing movement of leachates at existing sites. When further information from field observation and laboratory studies is available, it may then increasingly be possible to make predictions relevant both to those sites and to other sites for which some basic data is available. Already, however, there is substantial evidence from preliminary results of field investigations and laboratory/lysimeter research work to support the view based on experience that significant soil attenuation, retention and recovery mechanisms apply for some types of wastes, particularly when soil systems are not overloaded

9. A supporting approach to the study of leachate generating potential consists of developing standard leaching procedures which can be applied to the testing of wastes before they are landfilled. Standard leaching test procedures are currently being studied by several member countries, but it seems likely that the nature, purpose, and status of these procedures, when details are finalized, may differ considerable between countries.

10. In connection with the selection of sites for use as landfills, application of the findings of research investigations is already being made in participating countries, and site selection criteria are being developed for use by authorities responsible for waste disposal. At present, two main approaches seem to be used for selection of sites

    a) Sites selected on the basis of their ability to contain wastes and leachates, especially from hazardous materials.

    b) Sites which do not rely on containment, but which permit natural processes both within and outside the site to attenuate and disperse contaminants and to reduce concentrations of leachate components.

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11. Preliminary research results from the various programmes described in the project report, together with experience from many existing sites, suggest that the "attenuate and disperse" principle may in some cases have advantages on environmental and technical grounds to the "containment" approach. Nevertheless some countries still have substantial reservations about attenuation and similar effects and tend towards leachate containment, collection and treatment. Further results obtained from landfill research programmes will permit more detailed guidance on site selection to be provided, so that whichever approach is adopted, the risk of selection of unsuitable sites should be greatly reduced.

12. Methods of disposing of particular wastes at landfill sites, and site operational techniques in general, have not yet been studied systematically during investigations, but a few projects are currently in progress in member countries. Of particular importance is the extent to which co-disposal of domestic and industrial (including certain types of hazardous) wastes is applicable. At present, co-disposal is not practised in some countries, but in others it is used to varying degrees and in some is being extended. Co-disposal would not be appropriate for wastes with considerable recovery potential, nor for particularly hazardous wastes which might endanger public safety and the environment, but for a wide range of other wastes, there is in fact considerable scope for co-disposal in landfills.

G. Landfill Research Project (Phase II)

(a) Lead country: Canada

(b) Participating countries: Canada, Federal Republic of Germany, France, Netherlands, Norway, United Kingdom, United States of America

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(c) The objective of the phase 2 Landfill Research project was to continue with the assessment of the contribution that landfilling and "special chemical landfilling" can make towards an environmentally acceptable disposal of hazardous wastes with emphasis on the principle that sophisticated and energy costly treatment is not always necessary and can quite often be avoided, for instance in the case of low toxicity industrial wastes, if their long-term behaviour can be predicted.

The project and its report is then, in short, a continuation and update of the landfill project which was completed in 1977 as part of the first phase of the Pilot Study. It focused on the following specific areas of discussion which reflect main landfill areas being investigated by the participants:

- research conducted on co-disposal
- contaminant migration and attenuation
- waste isolation
- waste immobilization
- landfill procedures
- long-term effects
- leachate treatment
- national guidelines and/or regulations

Conclusions

1. Landfilling can be a suitable method for disposal of certain types of hazardous wastes provided proper precautions in the design, operation and post-operational care of the sites are taken to ensure adequate protection of the environment and public health on a long-term basis.

2. The results of landfill research can be used in the development of guidelines and codes to promote improvements in the "state of the art" of landfill practice. The landfill pollution problem, however, remains complex and further research is required to improve the basic

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understanding of the problem. It will be necessary to develop cost-effective and environmentally sound control and prevention technology particularly for the treatment of leachates, the lining of landfill sites, and minimizing the generation of leachates.

3. Most of the landfill research has focussed on conventional inorganic pollutants while research on micro-pollutants such as trace organics, has been very limited.

4. Research efforts to date have been directed mainly at the technical and scientific aspects of landfill problems while other aspects such as legal liability, site selection criteria and financial considerations for restoration and maintenance during and after active operation, have been largely neglected.

5. International cooperation and exchange of information has been helpful in improving the understanding and knowledge of the problems associated with landfill operations.

Recommendations

1. Long-term environmental and health concerns should be thoroughly examined during consideration of landfilling as a technique for disposal of hazardous wastes.

2. Further scientific research should be conducted on the use of landfill as a disposal and co-disposal method for hazardous waste. Such research should examine the potential problems with organic pollutants and leachate collection and treatment. Of particular interest is the entire question of leachate movement in soils and groundwater, and the health effects there of.

3. Legal economic, social and planning aspects of landfill disposal should be examined to improve the acceptability of landfilling of hazardous wastes where water pollution problems are unlikely to occur.

4. International cooperation and exchange of information should be encouraged and continued to enhance the transfer of knowledge and to promote the development and implementation of sound waste control and pollution prevention technology in landfills.

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H. Thermal Treatment Project

(a) Lead country: Federal Republic of Germany

(b) Participating countries: Canada, France, Federal Republic of Germany, Netherlands, Norway, United Kingdom, United States of America

(c) The project aimed at a description and evaluation of available and prospective techniques of thermal treatment applicable to hazardous wastes, and attempted a comparative assessment of different techniques with regard to different types of wastes. The assessment included treatment schemes for hazardous wastes alone, co-treatment of hazardous and non-hazardous wastes, and utilization of hazardous wastes as raw materials and/or supplementary fuels in thermal industrial production processes. It comprised land-based operations as well as incineration at sea. Finally, it was pointed out which role thermal treatment can play within an overall hazardous waste management scheme.
Major topics of concern were:

- pretreatmen of wastes
- technical d ils of thermal treatment
- management o residuals (solid, liquid, gaseous)
- usage of treatment residues
- relevant technical standards and guidelines
- technical problems, e.g., adverse effects and their reasons
- operational hazards.

Conclusions

1. The promulgation of air and water pollution control regulations has resulted in more effective removal of contaminants from waste streams, especially the hazardous constituents in many industrial effluent streams. These clean-up activities have resulted in an increased quantity of concentrated hazardous wastes that must be disposed of. Growing concern of the

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possible deterioration of the environment from current disposal methods has led governments to seek more acceptable ways for industry to dispose of its hazardous wastes.

2. Many disposal techniques have been utilized or proposed, none of which is problem free. Problem areas encountered include adverse environmental impacts, exessively high costs and scarcity of acceptable sites.

3. As the quantity of these wastes increases, the need for advanced waste management technologies becomes increasingly important. Even if carried out under strict control, landfill disposal is not effective for final deposition of certain types of hazardous wastes. In this respect, incineration as an integral part of the whole disposal concept is likely to be a more desirable environmental option for final disposal of many organic hazardous wastes, provided stringent controls are applied.

4. Recent trends in certain countries appear to indicate that the increase in hazardous waste generation has resulted in a corresponding increase in the construction of hazardous waste incineration facilities, which are likely to play an increasingly important role in the disposal of hazardous wastes.

5. The continued increase in oil prices is likely to result in a decrease in the availability of combustible wastes for ultimate disposal. Therefore, a prime factor in deciding on the construction and design of a new incinerator is to properly estimate the composition and amount of waste likely to be available in the future.

6. Experience shows that large capacity plants (depending on the calorific value and the amount of waste available) are preferable because of

   - economy of scale

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- the possible application of the best technology available consistent with technical and economic considerations.
- a better environmental control, and
- a greater variety of energy use (e.g. for emulsion separation, for evaporation of aqueous wastes or for thickening sludges prior to incineration).

7. Where there are insufficient satisfactory treatment and /or disposal options on land, incineration at sea is a viable disposal option under strictly controlled conditions.

8. Several thermal processes (e.g. pyrolysis) are being investigated which has led to the construction and operation of a few large-scale demonstration plants. Further investigations will consider reliability, availability, optimization of the plant throughput, utilization of the energy and raw materials obtained, treatment of the pollutants generated and, in particular, more precise determination of the operating costs. Specific results from these follow-up studies are not likely to be obtained in less than two years.

9. High costs have, in the past, limited the use of incineration but increasing costs and the potential liabilities associated with other techniques are making controlled combustion much more attractive. Since incineration is an expensive disposal option, it is hoped that other developments may be promoted to handle such wastes, in particular recycling. Alternatively, the primary interest of reducing the amount of waste at the producer end and the utilization of wastes as sources for energy or secondary raw material may be more rapidly approached.

10. Thermal treatment of hazardous wastes is basically (besides volume reduction) a method for the destruction of harmful substances virtually instantaneously in compact,

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controlled systems with no cost associated with long-term monitoring and no possibility of problems developing. For certain types of special wastes it is the most appropriate disposal method and should be applied irrespective of the short-term cost with respect to avoiding still higher costs which may otherwise subsequently arise, particulary from landfills after closure.

Recommendations

1. There is still little information available on
   - siting of thermal treatment plants
   - plant technology
   - waste types suitable for thermal treatment.

   Future investigation should therefore be focussed on these questions in order to obtain a more realistic basis from which a more widespread application of incineration can be derived.

2. Unless incineration is carried out under strict control, this disposal method basically replaces soil/water pollution resulting from landfilling by a possible unacceptable contamination of the atmosphere (e.g. dust and noxious gases). Thus research is needed:
   - to determine operating conditions and emission limits in relation to environmental impact
   - to develop and harmonize international regulations[1)]
   - to intensify the development of gas cleaning devices (filters, wet scrubbers, dry adsorption systems) for removing noxious gases as well as fine particles (< 0,1 microns) and aerosols from the flue gas and
   - to better define by-products of combustion.

   Research is also needed on corrosion problems.
3. Incineration is expensive even with energy recovery systems, although energy recovery both reduces the

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1) Although it is suggested that any regulations should be similar for all nations, a major debate still continues on "emission standards" versus "environmental quality objectives" for effluent discharges, depending upon the philosophical approach of the particular country.

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costs of incineration and saves fuel. At a time of rising energy prices the equipment of new incinerators with heat recovery devices should be considered in order to reduce the cost of incineration and/or to save fuel.

4. Co-incineration of hazardous wastes and municipal wastes can be applied if performed in a safe and environmentally acceptable manner. The potential for co-incineration warrants further investigation. Specifically the types and quantities of hazardous wastes in relation to the types and quantities of municipal waste needs to be determined.

5. When incinerating hazardous wastes they should be used as a fuel substitute as far as possible. The waste - as - fuel concept should be further investigated, particularly the use of hazardous wastes as a fuel supplement in cement kilns and power stations.

6. Prior to incineration, the development and application of new recovery techniques should be promoted, such as chlorine and HCl recovery from highly chlorinated organic wastes. Over a wide spectrum of scale a need has been identified for small plant of HCl recovery.

7. Whereas large companies often operate their own on-site waste disposal facilities, waste disposal options or plans need to be developed mainly for small to medium size waste generators. There should be cooperation therefore in the provision of centralized plants, if necessary, linked via transfer stations which could include certain pretreatment methods. Such disposal facilities could be constructed and operated by public or private funding or by a combination of both.

8. The pollution potential of incinerator residues (bottom ash, fly ash and scrubber sludge) needs to be determined more thoroughly since little information is currently available. In particular, residue characteristics in relation to input composition and incineration conditions,

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long term residue leaching, fly ash characterization and separation techniques require further research and development.

9. Evaluation procedures concerning environmental impacts and efficiency of incineration should be further developed. Efforts in this regard should aim at the elaboration of standardized incineration tests for use as a management tool.

10. On-site hazardous waste incineration should be subject to tne same regulations as for off-site hazardous waste incineration.

11. The development of new thermal treatment processes for hazardous wastes, e.g. pyrolysis, should be regarded as a supplement to the range of conventional methods of waste disposal and may offer more flexible options for the treatment of waste. In this context thermal treatment processes using halogenated wastes as halogen donors producing usable halides should also be considereded.

I. Chemical, Physical and Biological Treatment Project

(a) Pilot country: United States of America

(b) Participating countries: Belgium, Canada, Federal Republic of Germany, France, Netherlands, Norway, Portugal, Turkey, United Kingdom, United States of America

(c) In the project, information was assembled on the State - of - the - Art of Technology for Chemical/Physical and Biological Treatment of Hazardous Industrial Wastes in participating countries. This effort was directed at exploring of the alternatives to land disposal and incineration for management of industrial wastes. The following major topics were addressed by the project:

- Hazardous waste management policy which affects chemical, physical, and biological treatment applications in NATO countries.

- Identification of waste types and treatment processes applicable to hazardous wastes.

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- Future potential for recovery of hazardous wastes.
- The role of centralized treatment of wastes and the situation in each country.
- Current research and development efforts in applying chemical, physical, and biological treatment to hazardous wastes.

The findings of the project will serve as a source of ideas for both the countries which have advanced hazardous waste programs, and for those countries which are now beginning to recognize the problem and desire to establish a hazardous waste disposal system.

Conclusions

1. Most chemical, physical and biological treatment processes can reduce the volume or the hazard of waste to which they are applied. However, a residue usually remains which may require further treatment or disposal (i.e., chemical, physical, and biological treatment by itself is not always a cure-all).

2. Some conventional chemical, physical and biological treatment processes (such as neutralization) are well developed and widely applied to hazardous wastes at both on-site and centralized off-site facilities. Other processes are specific to particular wastes and are usually applied by the waste generator at on-site facilities.

3. Chemical, physical and biological treatment processes have the best potential to recover resources from wastes. Such recovery can play an important role in reducing the quantities of waste going to land and ocean disposal.

4. The technology for resource recovery and recycling of materials from hazardous waste is still in its early stages of development, except for waste oil and waste solvents.

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5. In most of the NATO countries, information on private-facility chemical, physical and biological treatment of wastes on site is proprietary and therefore is difficult to obtain.

6. In many NATO countries chemical, physical and biological treatment processes are widely used. Restrictions on land disposal, financial incentives, and specific requirements for resource recovery will further increase resource recovery by chemical, physical and biological treatment.

7. The recent increase in construction and operation of centralized treatment facilities in European NATO countries is expected to be repeated in Canada and the United States following implementation of regulatory programs. Much activity is anticipated over the next 5 to 10 years.

8. In many NATO countries, centralized C/P/B treatment facilities are for the most part privately owned. However, in a few cases, centralized facilities have been partially or wholely underwritten by regional or local authorities.

9. Research and development of chemical, physical, and biological treatment is being actively pursued by national governments, industry and other organizations in many NATO countries.

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Recommendations

1. In the evaluation of hazardous waste management alternatives, resource recovery of materials by chemical, physical and biological processes should be encouraged before thermal treatment, or land or ocean disposal.

2. The use of chemical, physical and biological treatment for hazardous wastes should be encouraged as a means to improve environmental protection and where these processes are technically and economically viable.

3. The research and development efforts of the member NATO countries, particularly in resource recovery from wastes and treatment of chlorinated organic wastes, should be encouraged where these processes are appropriate for environmental protection and are expected to be economically and technically viable.

4. Increased efforts are needed among nations to exchange information on hazardous waste treatment methods. Development of a uniform hazardous waste nomenclature system would facilitate this exchange of information.

5. The role of chemical, physical and biological treatment, including both on-site and centralized facility applications should be further evaluated in the context of the overall hazardous waste management system. The Organization for Economic Cooperation and Development (OECD) would be an appropriate organization for such an evaluation.

6. Many chemical, physical and biological treatment processes, especially those with potential for resource recovery, can and should be applied to non-hazardous industrial wastes, where technically and economically feasible, to reduce the amounts of waste requiring land or ocean disposal.

J. Metal Finishing Wastes Project

(a) Pilot country: France

(b) Participating countries: Canada, France, Netherlands, Federal Republic of Germany, United Kingdom, United States of America

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(c) The project dealt with the waste problems generated by the metal finishing industry and technical/organizational approaches to solve them. Based on contributions from participating countries the activities of the different branches of the industry were described and their respective pollution potentials were analyzed. The project addressed in particular the available control procedures by taking into account sequencies of plating operations and the application of low and non polluting production and treatment technologies. Special emphasis was given to the economic impact of different steps and degrees of effluent treatment. Finally, the project turned to existing legislation and practice with regard to effluent treatment.

Recommendations

1. Legislation and regulatory framework conditions are needed in the field of waste disposal and water pollution abatement to urge the metal finishing industry to employ less polluting processes and to increase their recycling and recovery activities.

2. Manufacturers in the metal finishing industry should be encouraged to establish registers by which the consumption of raw materials, the flow of waste materials and discharges to the environment are recorded.

3. Regulations should encourage the designation of a "Waste Manager" to be responsible within companies for measures against pollution. Such a waste manager must be trained in new technologies and should keep in close contact with pollution control authorities.

4. Training and information play an important role in reducing the environmental impacts of the metal finishing industry. In this regard it is necessary:

   - to make available detailed technical information to the industries concerned

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- to develop specialized professional training for managers of metal finishing shops on how to handle raw materials and minimize the environmental impacts of their activities

- to provide for standardized guidelines for operation and emission control.

5. The "polluter pays principle" must be strictly applied. Producers should pay taxes or fees according to the pollution and waste quantities discharged to the environment.

6. Research and development of simple and easily applicable technologies must be continued. In this context, the creation of "technical centres" should be encouraged which deal with the development of techniques to treat water effluents and to control material losses, and which give technical advise to industry and organize the necessary training.

7. Technology schemes should be promoted which have significant potential for recovery of waste materials from metal finishing processes.

8. In order to ensure an optimal treatment of metal finishing wastes, the services of specialized collective treatment centres should be considered, in particular by small or medium sized shops. Larger-scale treatment centres increase the economic efficiency of treatment and at the same time, the potential for material recovery.

9. The discharge of liquid wastes to sewage treatment plants should be allowed only when

   - there is no disturbance to the operation of the plant
   - there is no unacceptable contamination of the sewage sludge with hazardous substances, for instance cadmium
   - no surface waters are adversely affected.

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10. Temporary storage of sludges containing valuable materials for which recovery technologies are being developed, should be encouraged. Techniques for this storage will vary according to the materials contained and will have to be carried out under satisfactory conditions with regard to the environment.

V. Priority Areas in the Field of Hazardous Waste Management

In the following chapters problem areas are addressed which need further evaluation and particular attention in the future. The topics should be seen as priority tasks not only with respect to hazardous waste management but also in regard to the overall protection of the environment.

1. Approaches to the Definition and Classification of Hazardous Wastes

During the past ten years, the political and regulatory discussion has, to a large extent focussed on the question of what constitutes a hazardous waste. This discussion has not been completely fruitful, to the extent that an international consensus has not been achieved on this issue. The question has often been posed without indicating clearly the legal requirements which the definition and classification were required to satisfy. A frequent oversight is that the definition of hazardous wastes has to meet quite different criteria when one looks to the various elements of the overall disposal system. Requirements for the classification of hazardous wastes for transportation, disposal or treatment controls are likely to be more stringent than for purely administrative purposes.

As international discussion on this topic has not been sufficiently clear, it is not surprising that no common international definition or classification of hazardous waste exists and that each of the NATO-countries has its own approach in that area. Future discussions, therefore, should concentrate more on the question of the purposes for which some sort of classification is needed before continuing the dialog

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about how a hazardous waste should be identified.

There are three basic approaches in NATO countries towards the legal classification of hazardous waste: first, a pragmatic solution is achieved by describing the waste in a more qualitative way, indicating type, origin and constituents of the waste; second, a more scientific approach defining hazardous wastes by certain characteristics generally involving standard testing procedures; and, thirdly, definition of the waste in association with concentration limits of harmful substances. In the latter case the presence of certain listed hazardous components in a waste beyond a defined concentration makes a waste a hazardous waste.

All three approaches have their value and can be justified . The first one has the advantage that a legal system, based on that type of definition, can more easily be administered and enforced without too much bureaucratic difficulty. It also gives a certain flexibility to the waste disposal authorities in making qualitative judgements on individual waste disposal situations and, thus, in meeting practical needs. The effectiveness of this listing approach is essentially dependent on the legal system of individual countries,in particular the flexibility to make case by case decisions by the controlling authorities to incorporate problematic wastes in the hazardous waste control system.

The other two approaches have the advantage of presenting a clear and accurate description of wastes, theoretically leaving no doubt for the waste generator and waste disposer about how to deal with the waste. These precise definitions imply a tight control and surveillance of the definitions parameters which in practice may pose problems with respect to limited manpower, both on the part of waste generators and the controlling authorities.

Further experience has to be made in future in order to decide which one or which combination of the three approaches is most appropriate to ensure proper hazardous waste disposal at minimum administrative costs. This question must not be seen in isolation from the overall hazardous waste disposal system. The central objective of such systems is to dispose of the waste correctly, and this is less a problem of the definition of the waste than of actually applying disposal criteria and disposal opportunities. Until now there is no evidence in practice of a direct correlation between the quality of disposal and a high degree of accuracy in the legal definition of hazardous wastes expressed in terms of chemical composition, concentrations of toxic substances, etc. ...

2. Control Mechanisms for Hazardous Waste Disposal

The central task in each hazardous waste disposal system is, and will continue to be to ensure that a hazardous waste is directed along the right disposal route from waste generator to waste transporters and to a disposal facility, where the waste may be properly stored, treated, or disposed of. The surveillance of this waste transfer is perhaps the most difficult element to manage in the overall waste disposal control system, as far as the manpower to do it efficiently and the great number of individual checks which have to be performed are concerned. In particular, at the time when hazardous waste disposal systems are about to be established - the present situation in most industrialized countries - these efforts are indispensable.

Meanwhile, most of the NATO countries have enacted legal provisions which require the use of tripticket systems which permit off-site transport of hazardous wastes to be controlled following its generation. But it is true to say that, with a few exceptions, such tripticket systems are not yet enforced in NATO countries. This lack of enforcement has to be corrected in the future. In doing this, experience will be gathered which may allow rationalization in the application of tripticket systems. It is probable after some years of enforcing the system that the control authorities will be more familiar with the general movement of hazardous wastes in their country, so that the control costs might be reduced. The limited staff available to operate the control systems will certainly be a subject for further evaluation in all NATO countries.

The transport part of the overall disposal chain is, or can be, to a greater or lesser extent controlled by incorporating the transporters in the tripticket system, and/or by requiring a special license for the transport of waste. The latter requirement has proved very useful in some countries in selecting reliable transport enterprises from the great number of interested enterprises who offer their service.

An unresolved problem as yet is how to define and apply rules

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which cover the transport of hazardous waste from the viewpoint of traffic safety. Due to the complex and varying composition of hazardous wastes, no-one has yet succeeded making a clear indication to waste generators and transporters as to which special technical requirements should apply to the transport of hazardous wastes, in terms of vehicles, etc. Attempts have been made or are under wy to reach a pragmatic solution, allocating special types of waste and mixtures to the regulatory system dealing with the transport of hazardous goods. Major efforts will be needed in the future, on the part of transportation and waste disposal experts, to achieve a common understanding on this issue.

It is true to say that today the control of existing hazardous waste disposal facilities, in particular landfill sites, is often unsatisfactory from an environmental point of view. The operation of many facilities does not yet meet the quality standards the existing laws and regulations require. In the interest of the environment, and because of the long term nature of hazardous waste problems, concentrated efforts must be launched in all member countries to tighten the control of hazardous waste disposal, and to supervise the orderly management of disposal facilities.

In evaluating or introducing control measures in the field of hazardous waste disposal, it has to be born in mind that such measures cannot be looked at separately. Necessity, form and intensity of such measures are directly linked with the general disposal management concept. Control measures introduced at one stage of the waste stream control normally influence the control measures to be taken at consecutive stages. Thus, attempts to increase the efficiency of hazardous waste disposal control should never concentrate on isolated aspects but on the whole system.

3. Siting of New Hazardous Waste Disposal Facilities

The siting of new disposal facilities is perhaps the most urgent problem in the area of hazardous waste disposal which

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NATO countries face at present. After having introduced strong regulatory control mechanisms for proper hazardous waste disposal, most of the industrialized countries experience serious difficulties in offering waste generators sufficient technical and practical options (facilities) for them to treat their waste in the way required by laws and regulation. In many cases there is an obvious discrepancy between political objectives and regulatory requirements and the actual means of meeting them. The enforcement gap is not only a permanent threat to the environment, it also affects the credibility of and the trust in the quality and usefulness of legal provisions in place.

The central task is to get new hazardous waste disposal facilities with better technology and operating practices sited and built in the coming years. There is no other way to solve the existing disposal problems. Elected officials and all other parties concerned - public authorities, industry, private initiatives, individual citizens - should remember their responsibility in this respect and overcome the lethargy which to date often accompanies decision processes in this area. Elected officiales have to tell the truth to the public: without a positive and constructive attitude to the actual siting and installation of disposal facilities, the existing laws cannot really be enforced and the environmental situation will not improve or will be even worse in the future. An ongoing reluctance to take this attitude for political reasons may increase the uncertainty amongst the public on the necessity and value of new disposal facilities and thus stimulate further opposition to them.

Extensive efforts are needed to inform the public better on the technical criteria involved in hazardous waste disposal and on how far precautionary measures are taken to exclude or limit short term and long term risks. It has to be demonstrated to the public that disposal facilities are designed and managed properly so that people feel confident that things are done in the right way and in the interest of citizens themselves. NATO countries should cooperate in this field very closely by exchanging information on siting procedures and the operation of disposal plants so that one country can learn from the

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experiences found in another one.

In this context important questions come up which need further discussion in the future:

In the overall disposal context should large disposal and treatment centers be encouraged or should smaller-scale disposal facilities be the prefered option. The latter solution might in general be more easily accepted by the local population due to the fact that the concentration and movement of hazardous wastes is less in any particular area than in large scale operations. In contrast one of the advantages of disposal centers with greater capacity is that advanced treatment technology can be applied at reasonable cost and that the overall management and control of the disposal operations is rationalized.

A second major issue is whether on-site of hazardous wastes should be preferred to off-site treatment. For many types of industrial waste production, a greater proportion is treated on site. On-site operations do take place in the framework of general industrial production, and so far do not seem to have extra opposition from local population. Waste treatment is integrated into overall production processes as a more or less normal consequence of these activities. But even if on-site treatment is increased, it can only be part of the overall solution. This option is usually valid for major waste generators. With medium and small sized companies the situation is more difficult for on-site treatment, and for economic and environmental reasons off-site treatment is the usual option.

Finally, some countries may consider the option of mobile disposal facilities as a means of reducing the difficulties with siting stationary facilities. Limited to chemical/physical and thermal treatment, this option can only be considered as a partial solution to the siting of new permanent facilities.

4. Transboundary Disposal of Hazardous Wastes

Transboundary disposal of hazardous wastes is today a limited

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but nevertheless a quite common practice in many NATO countries. This way of disposal should continue in the interest of the environment and the economics of waste disposal and the spirit of international cooperation, provided that certain principles are observed:

- Basically, the disposal of one country's wastes in another country should only be practised if no appropriate disposal option exists at justifiable costs in the country of origin.

- Secondly, the import and export of hazardous wastes has to be subject to strict control, by both the importing and exporting country. Waste stream control must not stop at national frontiers but has to follow the usual route from waste generation to final disposal.

- Thirdly, transboundary disposal must not be considered as a means to escape any country's responsibilities with respect to hazardous waste management. Politically, it is unacceptable that one country should solve its waste problems by exporting a large proportion of its hazardous waste to another country. Import and export of hazardous wastes must be based on the principle of mutual help between countries and not motivated by a one-sided shifting of responsibility.

- In the future NATO countries and other countries should develop a common understanding and a set of international guidelines according to which transboundary disposal should take place. These considerations have not only to concentrate on the elaboration of permit and control requirements but also on the evaluation of political, economic and environmental criteria under which transboundary disposal may be useful and acceptable.

- A further important task in the future will be for countries to investigate and quantify waste streams passing their frontiers, and to make this information available to their neighbours and to other interested countries.

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5. Improvement and Harmonization of Hazardous Waste Disposal Quality in NATO Countries

The intensive discussions within the framework of the CCMS Pilot Study on Hazardous Waste Disposal have clearly shown that there exist basic differences in NATO countries in the way hazardous waste disposal is actually undertaken. This conclusion does not only concern infrastructures for hazardous waste disposal at different stages of development in terms of technical equipment and facilities, but also obvious differences in political attitudes and philosophies about how hazardous waste disposal should be carried out.

A priority task in the ensuing years should be to develop a more common understanding on technical disposal requirements and to achieve some sort of harmonization of disposal standards and quality. This harmonization is not only desirable for environmental reasons but also in order to create a fair and common reference basis for economic competition for the waste generating industry in different countries. This requirement holds true particularly for neighbouring countries, such as the European Allies of NATO, or the United States and Canada.

With regard to this objective, more efforts have to be made to put hazardous waste management on a sound scientific footing. Short and long term impacts of various treatment and disposal methods must be thoroughly investigated and put into perspective with health and environmental impacts from other human and industrial activities. The multiplicity of problems concerned often exceeds the experiences and research capacity of individual countries. Therefore, close international cooperation and exchange of information are urgent necessities in this matter.

The international discussion on hazardous waste disposal has in the past concentrated mainly on political objectives and regulatory instruments, and measures in terms of directives, conventions, etc. After this phase of defining the political

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framework, the time has now come to turn more from theory to practical solutions and to work hard on the improvement of the disposal system itself.

6. Relationship between Hazardous Waste Disposal and Environmental Protection in general

Experience in the past has shown that environmental protection has been understood mainly to date as oriented towards the environmental medium to a greater or lesser extent. For example, air and water pollution abatement policies have often been considered without enquiring how specific measures for protecting one medium, air or water, would affect the other one and which new waste problems would be generated.

This sectoral approach has often led (and still leads) to the situation where pollution problems are partially shifted from one environmental medium to another one. The limitation of air emissions causes new solid waste arisings in the form of sludges and dusts, often containing concentrated hazardous constituents; water purification means, in general, more waste sludges. In the end, many environmental measures result in an increase of waste quantities which are often very difficult to dispose of.

This simple connection following from the fundamental law of conservation of mass is not adequately considered in many attempts to improve the quality of the environment as a whole. One consequence of this policy is that the protection of the soil and groundwater has not received the same political interest as the other environmental media in the past. This picture is now changing under the pressure of serious soil pollution problems in nearly all NATO countries.

A sound policy can no longer afford a sectoral approach to the environmental problem. What is urgently needed is an integrated ecological approach considering air and water pollution abatement and waste disposal together. Waste disposal must

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become a more integrated part of any effort to clean air and water. Reciprocal measures and standards in these areas have to respect not only needs and requirements, but also technical possibilities and practical limitations of waste disposal. Otherwise, the obvious lack of enforcement in the area of hazardous waste disposal can be hardly overcome.

In the area of hazardous waste disposal itself an ecologically more general view of the problem is necessary. A striking example is the ongoing political discussion about the role High Sea Disposal has to play in an overall hazardous waste disposal concept. International conventions, in the first place the Oslo/London conventions, require a drastic reduction of sea disposal of industrial wastes but in many cases the question concerning which alternative disposal route on land should or could be followed instead has not been resolved, and still may not have been discussed. The different ongoing disposal practices concerning high sea disposal and the obvious uncertainty about how to proceed further in that area are a clear signal that the existing conventions have addressed but have not solved the problem.

From the environmental point of view,it is not a satisfactory solution simply to ban sea disposal without offering or indicating alternative sound disposal or treatment options on land. Efforts to reduce High Sea disposal have to be based on a well balanced evaluation of the marine and land environment and the impacts waste disposal has on the respective media.

7. Problem of Abandoned Disposal Sites

Nearly all NATO countries are presently faced with the serious problem of how to deal with unsafe deposits of hazardous wastes created in the past. Decades of industrial production have led to considerable amounts of hazardous waste materials often being distributed and dumped in a more or less uncontrolled way on land, near to the place of industrial production itself or arbitrarily elsewhere in the countryside.

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These sites, where hazardous wastes have been mismanaged in the past,often contain a wide variety of toxic and dangerous residues, and pose a permanent threat to human health and to the ambient environment. All industrialized countries are challenged by this threat and need to initiate a cooperative effort to identify and solve the existing problems in this area. They cannot afford to delay investigation of uncontrolled sites until after damages to the environment or public health accidents have occurred. It is important that member countries - public authorities and private industry - accept their responsibility and develop a positive and systematic program to tackle their national problems with abandoned disposal sites.

These efforts must be organized in three steps:

- the identification and characterization of unsafe disposal sites;
- risk assessment, e.g. assessment of the health and environmental hazards connected to such sites, and
- development and application of remedial actions to neutralize, contain,or remove the hazards.

These activities must be performed carefully and deliberately without making the mistake to consider the abandoned site problem as a homogeneous one. This problem differs from site to site. In general, each problem case needs an individual evaluation and solution.

The complicated nature of the problems concerned demands a sound scientific approach. In the search for a good practical solution care should be taken not to create some sort of hysteria or fright which in the end can hamper positive measures in the field. Instead, the public should be informed on where the risks are and how the risks can be brought under control. In this context it must be emphasized that the worker safety aspects of any work at problem sites, for instance excavations, need to be given careful attention.

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Experience and information gathered in the investigation of uncontrolled sites will be also important for the development and application of future disposal techniques. For example, those sites that have been identified as containing hazardous wastes but showing no environmental problems can be used to demonstrate acceptable disposal methods. On the other side, those problems identified with uncontrolled sites can be used to clarify what must be avoided at present or future sites.

8. Role of Recycling and Resource Recovery in the Area of Hazardous Wastes

In the overall management context for hazardous wastes, recycling and the application of low waste technologies must gain increasing importance. This is not only due to the contents of valuable raw materials in many wastes making resource recovery more and more economically attractive, but it is also a direct consequence of the pressure coming from more stringent requirements for hazardous waste disposal and the limited availability of high quality disposal facilities to meet these requirements. Therefore, in many situations the prevention of hazardous waste generation, either by recycling or reduction at source, is the only viable way to solve that part of the hazardous waste problem in a satisfactory manner.

Recycling is often understood as a purely economic activity running separately from disposal in the narrow sense of the word. This consideration neglects the important contribution recycling can make to reduce the waste problem, both with respect to the quantities and harmful constituents of the waste. What one needs in the future is the integration of recycling options into the overall waste disposal strategy. In this sense, recycling is not different from waste management, it must be part of it. This postulate implies a careful review of existing disposal practises with the scope to move systematically from "simple" disposal methods to more resource-saving treatment processes which at the same time

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reduce the environmental damage. The potential in that regard is still far from being fully used. This conclusion is proven, for example, by the considerable reduction of High Sea Disposal, which has been achieved mainly by recycling efforts in a relatively short time during the past few years.

9. Financial Responsibility and Liability for Hazardous Waste Disposal Facilities

Numerous past instances of human health and environmental damage resulting from abandonment of hazardous waste facilities have indicated the obvious need for financial assurance of closure and post-closure care. The likelihood of failure to provide adequately for closure and post-closure care is increased by the fact that the costs accrue when the economic value of the facility is diminished or has completely disappeared. For some disposal facilities, post-closure care must extend for decades beyond the operating life of the facility.

Significant numbers of facility owners may lack the ability to provide effectively for closure and post-closure costs unless they make provision for them during the active operating life of the facility. Several financial mechanisms have been discussed to provide such financial assurance, including trust funds, letters of credit, surety bonds, and the like. Funds for proper closure and post-closure care are thus assured regardless of the financial situation of the facility owner. Funds for providing this assurance can be collected as part of user fees during the facility's operating life, and are thus consistent with the "polluter pays" principle. User fees are then also truly reflective of the long term costs of proper hazardous waste management.

In some countries post-closure care is a central requirement set out and specified in the license for operating disposal facilities. The license is only given if certain responsibilities are accepted by the facility operator, including financial responsibility, to monitor, recultivate and ensure

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the safety of the disposal site after closure.

Liability requirements are necessary because of the potential for damage to people and property from hazardous waste management operations, as indicated by actual damage cases and the very nature of hazardous wastes. If the facility owner has insufficient financial resources to pay for damages, private parties or government may be forced to bear the costs. Liability protection is necessary and should be provided for both sudden ocurrences, such as fires and explosions, and for non-sudden ocurrences, such as slow migration of toxic constituents from hazardous waste landfills or surface impoundments.

In some countries liability for damages resulting from accidents associated with hazardous wastes, or from malpractice in their management, is already set out in the appropriate waste disposal legislation. The majority of countries, however, still try to determine liability through traditional channels in the framework of normal civil law.

The issues of financial responsibility and liability are in the very early stages of discussion in most of the NATO countries. Information and experience are still lacking which allow a decision for or against specific models in this area. It is therefore recommended that these important topics be studied in more depth by other international organizations.

10. Need for Research and Technology Development

Hazardous waste disposal is a continuing subject for research and development of new technology. Apart from the priorities addressed by the conclusions and recommendations of the individual projects of the Pilot Study (see chapter III of this report) further detailed research work is needed for the following areas:

- assessment of environmental risks related to hazardous wastes and different methods of disposal;

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- in-depth investigation of health effects from hazardous wastes both of acute and chronic nature;

- improvement of emission control techniques and measurement methods with scope to reduce further the emissions from hazardous waste treatment and disposal facilities;

- development of lower cost waste treatment and disposal technology

- elaboration of mathematical models as a tool for predicting mutual interactions between different types of wastes and the effects of hazardous waste disposal;

- development of technology for emergency responses.

The wide spectrum of research problems concerned, and the limited financial resources to address them, requires a sharing of the work among industrialized countries. On the basis of the succesful cooperation within the Pilot Study, NATO countries should develop mechanisms to avoid a duplication of work in the research area and to inform each other regularly on which research projects are being launched and which research results have been achieved. This information should also be shared with non-NATO countries.

VI. Continuation of Work of the Pilot Study by other International Organizations

The issue of hazardous waste disposal has met with increasing interest in the work of international organizations. In this way many aspects addressed by the Pilot Study are now discussed at an international level. This active international cooperation gives rise to hope that different national policies and attitudes in the field of hazardous wastes will gradually converge.

1. European Community

On 20 March 1978 the Council of Ministers of the European Community adopted a specific directive on toxic and dangerous

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wastes. The provisions of the directive had to be implemented by 20 March 1980 by the individual 9 Member States. The directive is only a kind of framework directive; it needs to be supplemented and amplified in more detail.

Taking this into consideration the European Commission has drawn up a mid-term working programme with the following priority tasks and measures:

- The examination of identification and accompanying documents relating to the transport of toxic and dangerous waste pursuant to the directive, particularly with respect to transfrontier carriage.

- The examination of documents relating to special regulations, particularly with respect to labelling, and to safety precautions in the event of hazards, accidents, etc.

- The examination of criteria for the monitoring and management of long-term landfill of toxic and dangerous waste.

- Transport problems.

- The examination of the question whether concentrations should be determined for the substances listed in the Annex to the Directive in order to determine more precisely, hazardous wastes falling under the directive, and if so, which.

- Particular problems of recycling, treating and disposing of certain forms of waste, such as organic halogen compounds, used solvents, waste derived from metal finishing and arsenic for which special codes of practice are to be drafted.

- Research and development endeavours, particularly the drawing up of a register of current (and completed) research and development projects run by the Member States and the Community, and identification of the research and development efforts still needed in this high-risk sector.

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A special working group of experts has been established in 1980 in order to elaborate proposals in the aforementioned problem areas.

2. Economic Commission for Europe of the United Nations (ECE)

In November 1979 a high-level meeting took place in Geneva in the framework of ECE on the Protection of the Environment. At this meeting a Declaration on Low- and Non-waste Technology and Reutilization and Recycling of Wastes was adopted by Member countries. As a result of the decisions taken at that meeting, a Working Party was established which also addresses the issue of toxic wastes.

Concerning this issue, in July 1980 the working party adopted the following programme of work for 1980 to 1984: consideration of policy measures for the handling, control and discharge of toxic wastes. Work will be carried out concerning the main sources of toxic wastes, as well as the ways in which amounts of such wastes could be significantly reduced through the use, inter alia, of modified technology or techniques of recycling.

The ECE-Secretariat will prepare reports for the annual sessions of the Working Party summarizing the current international activities in the field of toxic wastes.

3. Organization for Economic Cooperation and Development (OECD)

The OECD Waste Management Policy Group and the OECD Environment Committee adopted in October/December 1980 a detailed work programme for 1981/1982 devoted to the control of hazardous waste. The programme addresses the following specific problem areas for the initial phase:

a) Transfrontier Flow of Hazardous Wastes

Information will be gathered on the amount and nature of flows of hazardous wastes across national boundaries. Further topics, which will be studied, are:

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- the procedures that are followed to permit the transport of hazardous wastes across national frontiers;
- the costs of transporting hazardous wastes over long distances;
- the legal provisions covering liability for damage during the transport or storage of the wastes.

b) Industrial Compliance, Administrative, and Enforcement Costs

The objectives of this part of the work programme are:

- to characterise the extra costs to be borne by enterprises which modify their processes;
- to evaluate disposal or storage costs under the requirements of specific regulations;
- to identify particular industries where the burden of compliance costs may affect the viability of a significant proportion of the firms in the industry.

Concerning the administrative and enforcement costs the considerations concentrate on

- the operation of registration systems to monitor flows of wastes from generation to disposal;
- the inspection and approval of sites for hazardous waste disposal or storage;
- the inspection, determination and rectification of abandoned sites.

c) Insurance, Assurance, and Liability

Three basic issues are studied:

- the provision of liability insurance in case of accident;
- the determination of liability;
- the provision of assurance to ensure proper hazardous waste disposal site operation, decommissioning, and post-closure maintenance.

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As an additional activity in the field of hazardous waste, the OECD organized a special expert seminar on Hazardous Waste "Problem" sites in November 1980.

The purpose of the seminar was to put together and discuss practical experience gained so far with problems raised by closed or abandoned hazardous waste sites and to identify the kinds of research, technology and remedial actions needed for coping with the problems.

A comprehensive report has been completed in April 1981 for further consideration of the subject by the OECD Waste Management Policy Group.

4. World Health Organization (WHO)

In the framework of its European Programme on environmental health aspects and the control of toxic chemicals and in response to the decision of the Governing Council of the United Nations Environmental Programme on Export and Disposal of Hazardous Wastes, the Regional Office for Europe of the World Health Organization started in 1980 a work-programme aiming at the establishment of guidelines for the control of toxic and other hazardous wastes.

A working group was convened in Garmisch-Partenkirchen (Federal Republic of Germany) in March 1981 to discuss and finalize a draft document on guidelines. This document deals in a broad sense with the nature of the problem, definitions of hazardous waste, treatment and disposal options, and legal requirements such as liability, permits, licenses etc. It is intended to publish the finalized document as a separate manual in late 1981.

VII. Follow-up Activities of the Pilot Study

As was pointed out in the previous chapters of this final report, the Pilot Study has addressed an issue which is of extraordinary importance in nearly all NATO countries. Quite obviously,

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there is a wide variety of problems in the field which have not yet been satisfactorily solved. Permanent changes in the composition and quantities of hazardous wastes, new progress in research and technology and concentrated efforts to implement national hazardous waste disposal programs underline the fact that the present hazardous waste disposal scene is characterized by a rapid development. To keep track of this development should be the major task of the follow-up activities of the Pilot Study.

1. Reporting and Information Exchange System

Having recognized that hazardous waste disposal is an important international problem and taking into consideration the excellent cooperation which has been established among NATO countries by the Pilot Study, it is proposed that the follow-up activities ensure that close contacts are maintained between all countries who participated in the Pilot Study. An effective reporting and information exchange system should be organized, looking after ongoing developments in the area of hazardous wastes including activities in other international organizations. For these purposes a standing committee is to be created composed by members of the Pilot Study group and other experts nominated by Governments of NATO countries.

The terms of reference for this committee should be as follows:

- to review at regular intervals how conclusions and recommendations of the Pilot Study have been implemented;
- to evaluate the progress achieved in the enforcement of hazardous waste programs in NATO countries;
- to serve as a forum for the exchange of technical and scientific information and national initiatives and programs in the hazardous waste management field;
- to facilitate the establishment of compatible waste identification methodology through the standardization of definitions and criteria for identification of hazardous wastes;

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- to identify technical and scientific information gaps and assist in the development of priorities of research and technology development needs;
- to identify policy and major program concerns which require international discussion.

The standing committee should convene every twelve to eighteen months after the completion of the Pilot Study, in one of the NATO countries. The Federal Republic of Germany as Pilot country and the United States as Copilot are prepared to take alternately the chairmanship of the committee.

The standing committee will regularly report on its activities to CCMS plenary meetings.

2. International NATO/CCMS Hazardous Waste Symposium (Washington, October 5 - 9, 1981)

As a major international event in the field of hazardous wastes an international symposium will be held in the State Department in Washington DC, October 5 - 9, 1981. Hosted by the United States, this symposium aims at a comprehensive overview of the findings of the Pilot Study and at a presentation of the international status of hazardous waste disposal.

An international audience of people from industry, academia and national governments and authorities is expected to attend the symposium thus reflecting the worldwide interest in the topic and recognition for the Pilot Study.

Beyond the subjects dealt with in the individual projects of the Pilot Study, the symposium will address problems like

- the reduction and recycling of hazardous wastes;
- ocean incineration and disposal, and
- abandoned hazardous wastes sites.

In addition, information will be presented on the activities of other nations and international organizations in the field of hazardous wastes. Following the symposium there will be worldwide distribution of the proceedings.

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VIII. List of Publications

The following documents were published within the framework of the Pilot Study.

1. CCMS-document No 52 "Chromium Recycling"
2. CCMS-document No 55 "Manual on Hazardous Substances in Special Wastes"
3. CCMS-document No 62 "Recommended Procedures for Hazardous Waste Management"
4. CCMS-document No 63 "Organization"
5. CCMS-document No 64 "Landfill"
6. CCMS-document No 68 "Transportation"
7. CCMS-document No 69 "Underground Disposal"
8. CCMS-document No 70 "Pilot Study Final Report (Phase I)"
9. CCMS-document No 118 "Thermal Treatment"
10. CCMS-document No 119 "Chemical, Physical and Biological Treatment"
11. CCMS-document No 120 "Landfill Research (Phase II)"
12. CCMS-document No 121 "Metal Finishing Wastes"
13. CCMS-document No 122 "Pilot Study Overall Final Report"

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